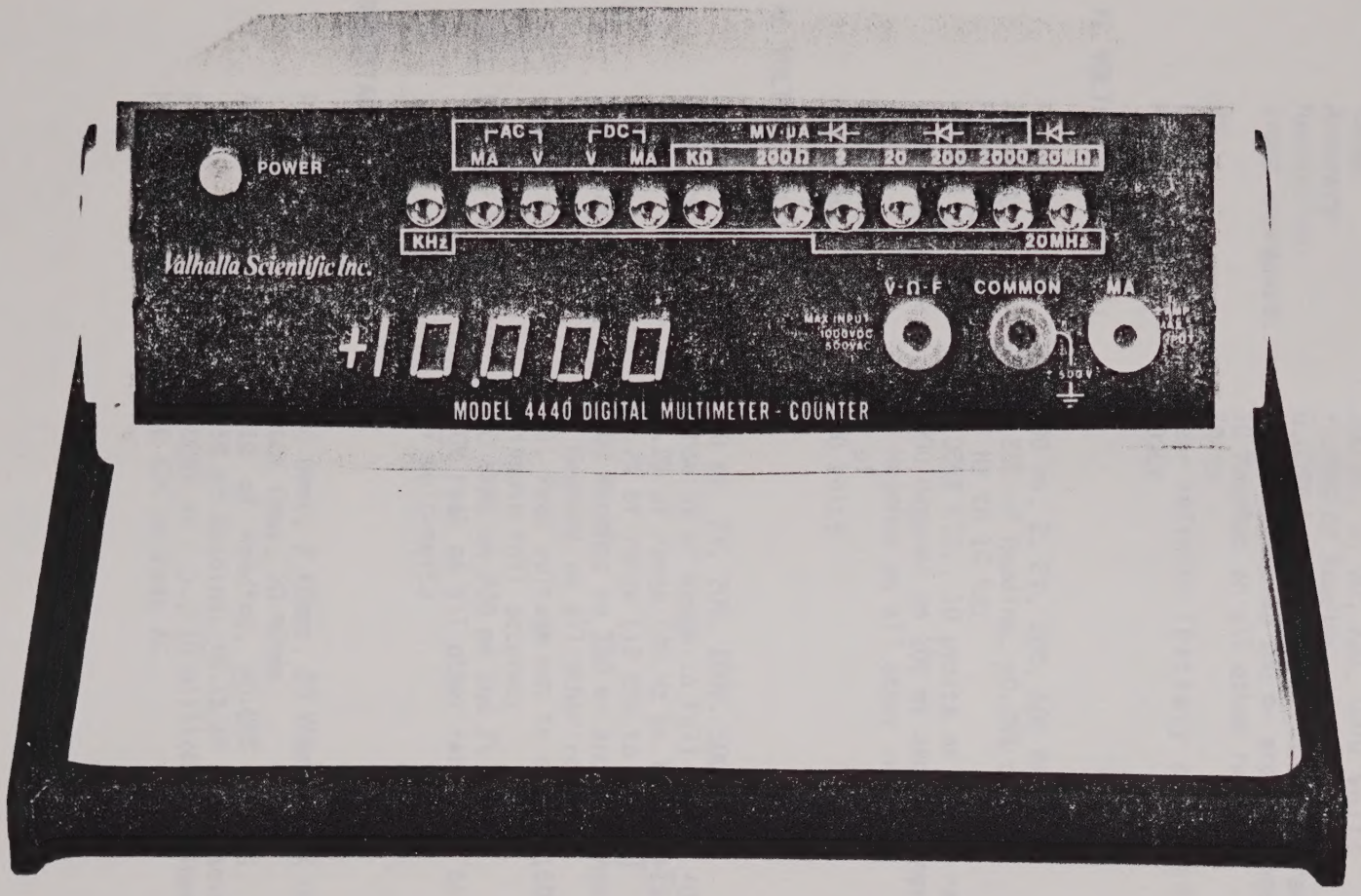
INSTRUCTION MANUAL

4440



MODEL 4440

DIGITAL MULTIMETER-COUNTER

MODEL 4440

SPECIFICATIONS

DC VOLTS

Range:	200 mv, 2, 20, 200, 1000 volts
Accuracy:	±0.05% of Reading, ±0.025% F.S.
Resolution:	0.005% F.S.; 10μvolts on lowest range
Input Impedance:	1000 Megohms on 200 mv and 2V range 10 Megohms on all other ranges
NMR:	50 db
CMR:	Near infinite (Battery operated)
Max Input:	1000V

AC VOLTAGE (AVERAGING)

Range:	200 mv, 2, 20, 200, 500 VRMS
Accuracy:	0.25% of Reading, ±0.25% of F.S.
Frequency:	45 Hz to 10 KHz
Resolution:	0.005% F.S., 10 μvolts on lowest range
Input Impedance:	1000 Megohms on 200 mv and 2V range 10 Megohms on all other ranges
Shunt Capacity:	50 pf
Max Input:	500 volts

AC VOLTAGE (RMS)

Ranges:	200 mv, 2V, 20V, 200V. 500v
Accuracy:	(From 5% of Range to Full Scale) ±0.5% of reading ±0.2% of range (40 Hz to 10KHz) ±1% of reading ±0.2% of range (10 KHz to 20 KHz)
Input Impedance:	1000 Megohms on 200 mv and 2V range 10 Megohms on all other ranges
Crest Factor:	3:1, Peak voltage not to exceed 150% of range to maintain full accuracy
Maximum Safe Input:	130 VRMS on 200 mv and 2V range 750V Peak on all other range not to exceed 10^7 volt-hertz

RESISTANCE

Range:	200 Ohms, 2 KOhms, 20 KOhms, 200K Ohms, 2000K Ohms, 20 MOhms
Accuracy:	0.1% of Reading, ±0.05% of F.S. to 2 MOhms; 0.5% of Reading, ±0.1% of F.S. above 2 MOhms;
Resolution:	0.005% of F.S.; 10 milliohms on lowest range
Max Input Volts:	250 VDC or Peak AC

FREQUENCY COUNTING

Range:	2 KHz, 20 KHz, 200 KHz, 2000 KHz, 20 MHz
Accuracy:	0.01% of Reading, ±0.005% of F.S.
Resolution:	0.005% of F.S.; 0.1 Hz on lowest range
Gate Time:	1 KHz - 10 sec.; 10 KHz - 1 sec.; 100 KHz - 0.1 sec.; 1000 KHz - 0.1 sec.; 10 MHz - 0.1 sec.
Sensitivity:	100 mv to 1 MHz; 250 mv to 20 MHz

DC CURRENT

Range:	200 µa, 2, 20, 200, 2000 ma
Accuracy:	±0.3% of Reading; ±0.05% of F.S.
Resolution:	0.005% of F.S.; 10 na on lowest scale
Current Shunt Voltage Drop:	200 mv F.S.
Max Input:	2 amperes on all ranges (Fuse protected)

AC CURRENT (AVERAGING)

Range:	200 µa, 2, 20, 200, 2000 ma
Accuracy:	1% of Reading ±0.1% of F.S. to 10 KHz
Resolution:	0.005% of F.S.; 10 na on lowest range
Max Input:	2 amperes on all ranges (Fuse protected)

AC CURRENT (RMS)

Ranges:	200 µa, 2, 20, 200, 2000 ma
Accuracy:	(From 5% of range to Full Scale) ±1% of reading ±0.2% of range
Voltage Burden:	0.25V RMS maximum except 2000 ma range 0.7V RMS maximum on 2000 ma range
Crest Factor:	3:1, Peak current not to exceed 150% of range to maintain full accuracy

GENERAL

Display:	LED's 0000 to 19999
Accuracy:	Specifications apply for 25°C ±5°C for 90 days
Temperature:	0 to 50°C
Max CMV:	1000 volts
Conversion Rage:	Approximately 3 per second
Overload Indication:	Flashing display
Autopolarity:	Bi-polar displays (+) and (-)
Size:	8 1/2 W x 3 1/2 D x 2 1/2 H
Weight:	Approximately 3 lbs.
Power Source:	Disposable "D" cells supplied, rechargeable battery optional

Specifications apply when tested in accordance with standard Valhalla Scientific test procedures.

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SECTION I

GENERAL INFORMATION

1-1 DESCRIPTION

1-2 The Valhalla Scientific Model 4440 Digital Multimeter-Counter is a complete wide-range multifunction measurement system in one package. This instrument measures: DC Voltage, AC Voltage, DC Current, AC Current, Resistance and Frequency. The Model 4440 features overload protected input ciucuits on all ranges and functions to insure damage free operation when operated within specified limits. It is powered with disposable "D" cells or with rechargeable nickel cadmium batteries.

1-3 ACCESSORIES

1-4 The Valhalla Scientific Model 4440 is shipped from the factory with a set of disposable "D" cells, or rechargeable batteries if the option is exercised, and an instruction manual.

1-5 AC CHARGER - OPTION A

1-6 The AC Charger option consists of a power transformer and rectifier system, in a sealed package, that plugs into the 115 VAC wall outlet and into the rear of the instrument. It will remove the load from the disposable batteries, thereby extending their useful life. The unit will charge nickel cadmium batteries and simultaneously power the instrument from the AC outlet.

1-7 RECHARGEABLE BATTERIES - OPTION B

1-8 The rechargeable battery option consists of four "D" size Nickel Cadmium cells that will power the instrument for 8 hours of continuous operation in the multimeter mode or for 6 hours in the frequency counter mode between recharging of the cells.

1-9 20 MHz COUNTER - OPTION F

1-10 The 20 MHz Counter option adds crystal controlled frequency counting capability up to 20 MHz. An automatic gain control on the input stage eliminates any adjustments over the dynamic range providing "hands off" operation.

1-11 TRUE RMS TO DC CONVERTER - OPTION TRMS

1-12 The Option TRMS allows the user to accurately measure non-sinusoidal wave forms.

1-13 EXTERNAL 20 AMPERE CURRENT SHUNT - OPTION I

1-14 The unit may be purchased with the external 20 Amp shunt option which extends the AC and DC current ranges to 20 Amperes full scale.

1-15 TEMPERATURE PROBE - OPTION TEMP

1-16 The option TEMP Temperature Probe will accurately measure surface temperatures from -50°C to 150°C.

1-17 HIGH VOLTAGE PROBE - OPTION HV-2

1-18 The High Voltage Probe, Option HV-2 extends the range of the basic instrument to 36,000V with 2% accuracy.

1-19 INTERNAL LINE POWER - OPTION AC

1-20 Option AC provides power directly from 115 VAC line, 200 VAC 50 Hz also available.

1-21 INPUT CABLE SET - OPTION C

1-22 The Model 4440 Option "C" Input Cable Set provides direct compatibility with the front panel input connectors through shielded conductor. The input leads are terminated in two alligator clips.

SECTION II
INSTALLATION

2-1 INTRODUCTION

2-2 This section contains information for the inspection and installation of the Valhalla Scientific Model 4440 Digital Multimeter.

2-3 INITIAL INSPECTION

2-4 Before accepting the instrument from the shipper, inspect the shipping container for any signs of external damage. If damage is observed, please notify the carrier.

2-5 Unpack the instrument and retain the shipping container until the instrument has been inspected for possible damage in shipment.

2-6 POWER REQUIREMENTS

2-7 The Valhalla Scientific Model 4440 Digital Multimeter-Counter operates from a DC power supply consisting of four disposable "D" cells furnished with the instrument. Alternately, nickel-cadmium batteries may be used to extend the operational time between battery replacements. A charger is available as an option (see Section I) that will remove the load from the batteries when connected to the 115 volt AC wall outlet. It will also charge nickel cadmium batteries and simultaneously power the instrument from the AC outlet. Normal operating time between charges of the nickel cadmium batteries is 8 hours of continuous operation in the multimeter mode or 6 hours in the counter mode.

2-8 INSTALLATION

2-9 The Model 4440 is a low power device that generates little or no heat. Therefore, there are no special installation considerations other than to insure that its ambient environment is within the temperature range specified.

SECTION III

OPERATING INSTRUCTIONS

3-1 INTRODUCTION

3-2 This section contains complete operating instructions for the Model 4440 Digital Multimeter-Counter. Included is a description of the front panel controls and a list of procedures required to operate the unit in each of its measurement modes.

3-3 FRONT PANEL

3-4 The POWER SWITCH is a single push-on push-off control located at the extreme right hand side of the panel. This control energizes and de-energizes the instrument.

3-5 The FUNCTION SWITCH is a six-station, interlocking pushbutton unit located in left center of the panel. This control selects any of the six functions, KHz, AC MA, AC V, DC V, DC MA, or KΩ. In the event the KHz option is not exercised, then the KHz control is not present.

3-6 The RANGE SWITCH is a six-station, interlocking pushbutton unit located to the right of the panel center line. This control selects any of six multipliers to provide a wide range of inputs. The legends above the switch pushbuttons provide a quick reference when selecting a new range.

3-7 DC VOLTAGE MEASUREMENTS

The maximum safe input is 10,000% of range not to exceed 1000 VDC.

1. Press RANGE switch to 2000.
2. Press FUNCTION switch to DCV.
3. Connect the unknown input voltage across the front panel V-Ω-F and COMMON terminals.
4. Observe the reading and select the range that will yield the proper resolution.

3-8 DC CURRENT MEASUREMENTS

The maximum safe input is 500% of range not to exceed 2A.

1. Press RANGE switch to 2000.
2. Press FUNCTION switch to DCMA.
3. Connect the unknown input current across the front panel MA and COMM input terminals.
4. Observe the reading and select the range that will yield the proper resolution.

3-9 AC VOLTAGE MEASUREMENTS

The maximum safe input is 10,000% of range not to exceed 500V rms.

1. Press RANGE switch to 2000.
2. Press FUNCTION switch to ACV.
3. Connect the unknown input voltage across the front panel V-Ω-F and COMM input terminals.

4. Observe the reading and select the range that will yield the proper resolution.

3-10 AC CURRENT MEASUREMENTS

The maximum safe input is 500% of range not to exceed 2A.

1. Press RANGE switch to 2000.
2. Press FUNCTION switch to ACMA.
3. Connect the unknown input current across the front panel MA and COMM input terminals.
4. Observe the reading and select the range that will yield the proper resulution.

3-11 RESISTANCE MEASUREMENTS

The maximum safe input voltage is 200 VDC or peak AC.

1. Press FUNCTION switch to KΩ.
2. Press RANGE switch to 20 MΩ.
3. Connect the unknown input resistor across the front panel V-Ω-F and COMM input terminals.
4. Observe the reading and select the range that will yield the proper resolution.

NOTE

Use a shielded input cable when measuring high resistance values.

3-12 FREQUENCY MEASUREMENTS (with Option F installed)

The maximum safe input voltage is 250V rms.

1. Press FUNCTION switch to KHz.
2. Press RANGE switch to 20 MHz.
3. Connect the unknown input frequency across the front panel V-Ω-F and COMM input terminals.
4. Observe the reading and select the range that will yield the proper resolution. Out of range indications are characterized by a flashing display.

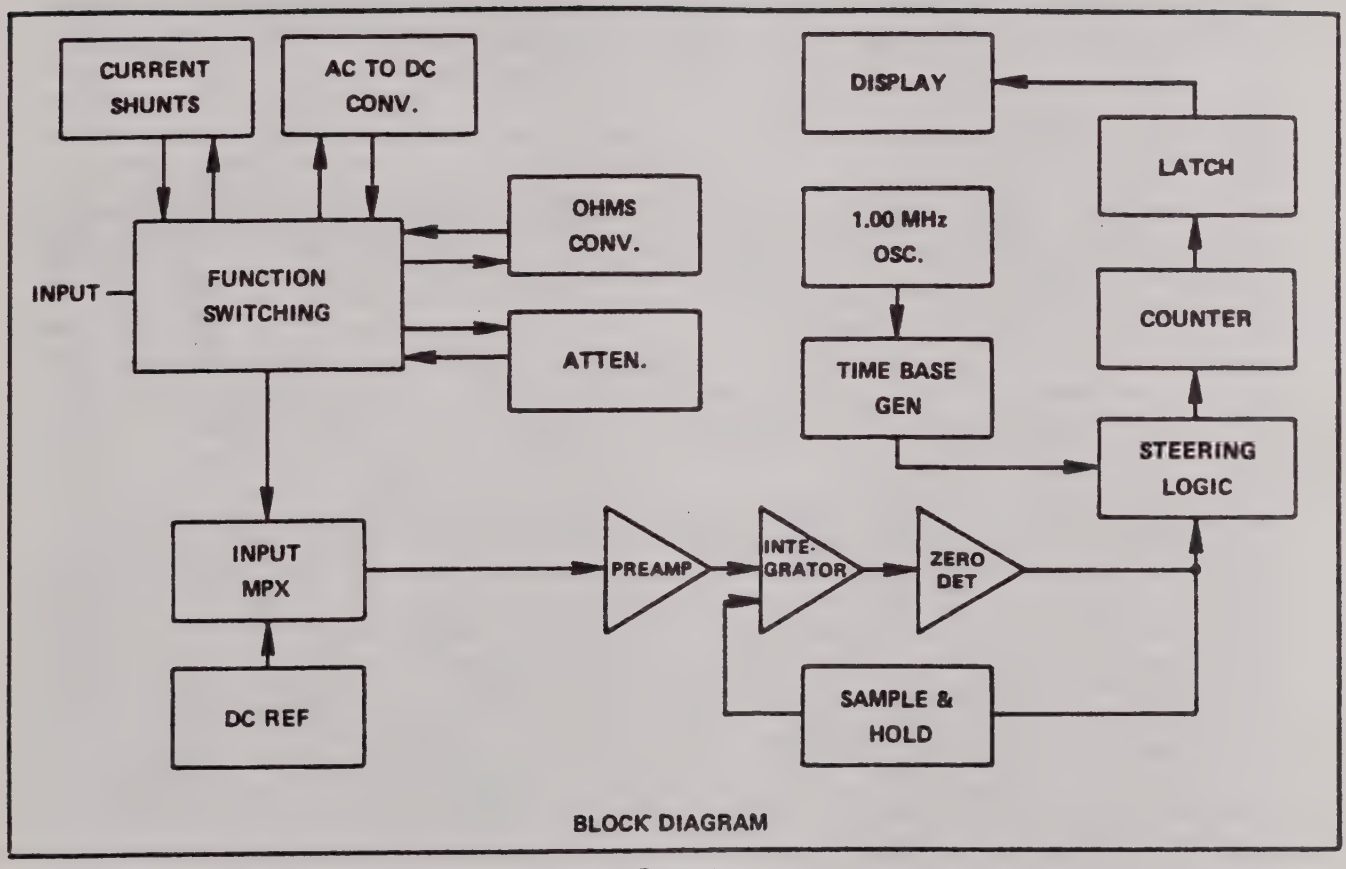

CURRENT SHUNTS
AC TO DC CONV.
DISPLAY
LATCH
OHMS CONV.
1.00 MHz OSC.
INPUT
FUNCTION SWITCHING
ATTEN.
COUNTER
TIME BASE GEN
STEERING LOGIC
INPUT MPX
PREAMP
INTE-GRATOR
ZERO DET
DC REF
SAMPLE & HOLD
BLOCK DIAGRAM

Figure 4-1

SECTION IV

THEORY OF OPERATION

4-1 INTRODUCTION

4-2 The Valhalla Scientific Model 4440 Digital Multimeter-Counter is basically a precision analog to digital converter (A/D) that measures and displays DC voltages. The measurements of DC current, AC voltage, AC current and resistance are accomplished by first converting these inputs to DC voltages and then measuring them with the precision A/D converter. Frequency measurements are made by gating the unknown input frequency into the decade counter for a fixed period of time. The instrument is completely solid state and used CMOS integrated circuits almost exclusively to minimize the power required for operation. It is basically a DC powered unit using four "D" size cells of the disposable or rechargeable type.

4-3 FUNCTIONAL DESCRIPTION

4-4 A/D CONVERTER

4-5 The Model 4440 uses a three step integration process for converting analog input voltages into digital information. The first step is 200 milliseconds long and is the RESTORE mode. In this mode, the input to the amplifier, IC12, is grounded through one section of the quad-bilateral switch, IC2. The sample and hold switch, Q15, is ON, closing the feedback loop around the integrator, IC13, and the zero detector, IC14, to drive the output of the zero detector to zero and charge capacitor C21 to the level required to hold the output at zero in the absence of an input voltage. Any offsets in the preamplifier, integrator or zero detector are automatically cancelled out.

4-6 The second step in the process integrates the unknown input voltage and begins by disabling Q15 and connecting the input of the amplifier to the input of the instrument. Depending on the selected range, the amplifier will operate at a gain of 1 or gain of 10. A gain of 10 is selected by grounding R28 through one section of the quad-bilateral switch, IC3, in the ranges of 200mv, 20V and 2000V. In the other ranges the switch is open, R28 is not grounded and the gain is 1. The output of the amplifier is applied to the input of the integrator. The integrator output will rise to a level proportional to the input. During this period, the polarity of the output of the zero detector will be applied to the D input of one half of the dual D flip-flop, IC6. The integration will last for 100 ms. At the end of that time, the input to the flip-flop will be clocked through to its Q output storing the input polarity information.

4-7 At the beginning of the third step, the input of the preamplifier is disconnected from the unknown input and connected to a reference voltage of a polarity opposite to that of the unknown input voltage. The polarity stored at the Q output of IC6, terminal 1, determines which of the two reference voltages is applied to the input of the preamplifier. Whereas the slope of the integrator output and the level at the end of integration was a function of the input voltage in the preceeding step, the slope during integration of the reference is constant. Therefore, an accurate measure of the time to integrate the reference to zero is an accurate measure of the input voltage. During this period, the crystal controlled clock is being

counted by IC7. When the zero detector output passes through zero, the counting of the clock is stopped and the count displayed on the LED readout. The zero detector also sets the monostable comprised of IC4 8-9-10 and IC4 11-12-13 which sets the unit back into the RESTORE mode for a period of 200 ms.

4-8 REFERENCE AMPLIFIERS

4-9 The two reference voltages, one positive and one negative, which will be applied to the input of the preamplifier during the third step of the measurement process must be precise and equal. These are developed in two of the amplifiers in IC15. The current for the reference zener is obtained from constant current source, Q9. The zener voltage is sensed by IC15 at terminal 3 and the feedback from the output to terminal 2 is selected to create an output of approximately -1.05 volts. This negative voltage is then applied to input terminal 6 through R66. The gain of the second amplifier of IC15 is set at -1 and the output is +1.05 volts. The feedback loop to the non-inverting input, terminal 5, of IC15 is from potentiometer R61 and permits adjustment of the balance between the two reference voltages. The two outputs are then connected to the quad-bilateral switch, IC2, which will switch the correct polarity to the voltage divider comprised of R21, R22, R23 and R24. The other quad-bilateral switch, IC3, will connect +1 volt, +0.1 volt, -1 volt or -0.1 volt to the input of the preamplifier depending on the polarity of the input signal and the gain of the amplifier as determined by the selected range.

4-10 AC TO DC CONVERTER

4-11 The Model 4440 is basically a DC voltmeter. It is necessary to rectify the AC input before applying it to the input of the A/D Converter. Rectification and amplification are accomplished in the circuits associated with Q7 and IC16. The AC input is applied to Q7, which operates as a source follower, through C9 and R38. Its output is coupled through C10 to the voltage divider R33-R34. The input to IC16 at terminal 3 is one-half of the input at Q7. The output of IC16 is coupled, through C16, to two diode rectifiers, CR7 and CR8. Through the network of R44-C17 and R45-C18, the output connects back through C15 to the inverting input of the amplifier. The amplifier will operate at a gain of 1 in the 2 volt full scale range. In the 200 millivolt range, the series combination of R36 and R37 is connected to ground, thereby changing the input level to terminal 2 of IC16 and the gain is increased to 10. The voltage at the cathode of CR8 will be the same for a 100 mv input as with a 1 volt input. The rectified AC is filtered through R46, R47 and C19. The DC component at the junction of R46 and R47 is proportional to the RMS value of the input AC voltage. This DC voltage is applied through the selector switch assembly to the input of the DC voltmeter section. The gain of the AC amplifier is 10 in ranges of 200 mv, 20 volts and 2000 volts. In ranges of 2 and 200 volts, the amplifier gain is 1.

4-12 OHMS TO DC CONVERTER

4-13 The OHMS to DC converter functions to generate a constant current through the unknown resistance connected across the input terminals. The voltage drop across the unknown is measured by the DC voltmeter and displayed as the unknown resistance.

The constant current source is comprised of two sections of IC15, IC17, Q8 and associated components. The +1.05 volt reference of IC15 terminal 7 is applied to terminal 13 through R58 and R59. The feedback to the summing junction is adjusted with R69 to produce -1V at the output terminal 14. This is applied to a floating differential amplifier input, terminal 9 of IC15. The positive feedback for this amplifier is from a voltage divider between the constant current source output, cathode of CR9, and ground. The output of the floating differential amplifier drives one input of IC17, which, in turn, drives the constant current source, Q8. The amount of current that will flow in the external resistance will be determined by the resistance between the constant current source output and the lower end of R75 which is connected to the input terminal. In the 200Ω and 2KΩ ranges, the resistance is comprised of a single 1K ohm resistor, R90. The current through the unknown resistor is 1 ma. In the 20KΩ and 200KΩ ranges, a 99K ohm resistor, R84, is switched in series with R90 for a total of 100K ohms and the current is 10 microamps. In the 2MΩ and 20MΩ ranges, R83, a 9.9M ohm resistor, is added for a total of 10M ohms and the current is then 100 nanoamps.

4-14 FREQUENCY COUNTER

4-15 The frequency counter is a crystal controlled true gated time counter. The precision time bases are derived by a 1 MHz crystal driving a series of decade counters. The counters are contained in IC11 and are programmed by the range switch to count the crystal oscillator to 100,000 for the 0.1 second gate, to 1,000,000 for the 1 second gate and to 10,000,000 for the 10 second gate. During the count time, the gate is open and the unknown frequency is counted in IC7 and displayed on the LED readout at the end of the gate time. The unknown input frequency is applied to the gate of Q13 which is protected from overvoltage by the circuit of Q14. Q13 operated as a source follower and drives NAND gate IC18 to produce a square wave at terminal 6. In the four lower ranges, the output of IC18 is applied directly to the input of IC7. In the 2 MHz range, it is first divided by 10 in IC19 and then applied to the input of IC7. In the 20 MHz range, it is first divided by 10 in IC19 and then again by 10 in IC20 for a total division of 100. The input to IC7, then, will never be greater than 200 KHz.

4-16 LED DISPLAY

4-17 At the completion of the count, in any mode of operation, the count is stored in four registers in IC7. IC7also has an internal oscillator which is set by C4 to approximately 10 KHz. There are four output terminals on IC7 (2,3,23 and 24) which are connected to decoder-driver IC10. These will be sequentially connected to the four internal registers of IC7 at a 10 KHz rate. Simultaneously, the four driver transistors, Q2 through Q5, will be turned on sequentially. When the data for the most significant digit is connected to the output of IC7, Q5 will be turned on and the decoded data will appear on DS2. When the next most significant digit data is connected to the output terminals of IC7, Q4 will turn on and the data will appear on DS3. The same process continues for DS4 and DS5 and then the process is repeated. Since the strobe rate is 10 KHz, the eye sees the display as being continuously illuminated.

SECTION V
MAINTENANCE

5-1 INTRODUCTION

5-2 This section contains the maintenance information for the Valhalla Scientific Model 4440 Digital Multimeter-Counter. Included in this section are the required test equipment list and calibration procedures.

5-3 REQUIRED TEST EQUIPMENT

5-4

EQUIPMENT	REQUIRED PERFORMANCE
DC Voltage Standard	±0.003% accuracy 0.1V to 1000V
AC Voltage Calibrator	±0.02% accuracy 0.1V to 500V RMS
DC Current Calibrator	±0.01% accuracy 0.1MA to 1000MA
AC Current Calibrator	±0.05% accuracy 0.1MA to 1000MA RMS
Precision Resistor Set	±0.005% accuracy 100 ohms to 10M ohms
Oscilloscope	50MVDC/CM Sensitivity

5-5 CALIBRATION PRODCEDURE

5-6 The following procedure should be performed on a routine basis to insure that the instrument remains within calibration. The calibration procedure should be performed after repairs to any of the accuracy determining components. Apply power and allow 5 minutes for the instrument to warm up.

5-7 DC VOLTAGE CALIBRATION

NOTE

Calibration adjustments and locations are identified in the instrument's cover for calibration convenience.

5-8 Select the DC V function and the 200mv range. Apply an input of +0.00010 volts DC and adjust the reading. Apply an input of -0.00010 volts DC and adjust R60 until both the + and - inputs produce the same display indication. After both inputs produce the same indication adjust R3 until the display indicated ±00.08 or ±00.09.

5-9 Select the DC V function and the 200 mv range. Apply an input of +100.00 mv DC. Adjust R23 until the display indicates +100.00 ±2 digits.

5-10 Select the DC V function and the 2V range. Short the input and adjust R108 until the display indicates 0.000.

5-11 Select the DC V function and the 2V range. Apply an input of +1.0000 volts DC. Adjust R21 until the display indicates +1.0000 ±2 digits.

5-12 Select the DC V function and the 2V range. Apply an input of -1.0000 volts DC. Adjust R61 until the display indicates -1.0000 ±2 digits.

5-13 RESISTANCE CALIBRATION

5-14 Select the KΩ function and the 2K ohms range. Connect a 1.0000K ohm resistor to the input terminals and adjust R69 for an indication of 1.0000 ±2 digits.

5-15 AC VOLTAGE CALIBRATION

5-16 Select the ACV function and the 2 volt range. Apply 1.0000 VRMS at 1 KHz to the input terminals and adjust R42 for an indication of 1.0000 ±5 digits.

5-17 Select the ACV function and the 200 mv range. Apply 100.00 mv RMS at 1 KHz to the input terminals. Adjust R36 for an indication of 100.00 ±5 digits.

5-18 Select the ACV function and the 20 volt range. Apply 10.0000 VRMS at 10 KHz to the input terminals and adjust C37 until the indication is 10.000 ±5 digits.

5-19 FREQUENCY COUNTER CALIBRATION

5-20 Select the KHz function and the 10KHz range. Apply a 0.1 volt RMS AC input and adjust KHz bias control, R102, for maximum sensitivity.

5-21 The remaining ranges and functions require no further calibrations. If verification of accuracy is required, apply a known input near full scale and check for specified accuracy.

5-22 TROUBLE SHOOTING

5-23 Difficulties often arise due to misinterpretation of specifications or noisy inputs. Check carefully that the instrument is truly malfunctioning before attempting to repair it.

5-24 Whenever attempting to repair a complex system, it is beneficial to isolate the malfunction to as small an area as possible before troubleshooting the malfunction. for example, if a malfunction occurred measuring a 100K ohm resistor, first check the lower resistance ranges, then check the 200 mv DC range. With this process, the malfunction may be isolated to a small area quickly.

5-25 The following table (Figure 5-1) is a functional description of the gates used in the Model 4440. For specific pin numbers, refer to the schematic diagram. All logic used in the Model 4440 is positive "1" state.

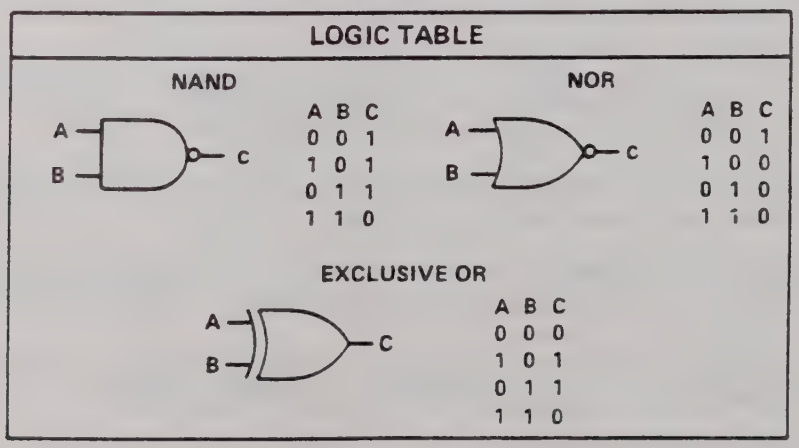


Figure 5-1

5-26 POWER SUPPLIES

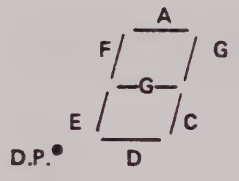
5-26 The +5 volt supply is obtained directly from the battery pack. The voltage will vary from 4.5 volts to 6.4 volts depending on battery type and condition. The -5 volt supply is obtained from a DC to DC converter and voltage regulator system. The DC to DC converter is comprised of T1, Q11 and Q12. The secondary output of T1 is rectified and filtered and then regulated to 5 volts by the emitter follower, Q10.

5-27 The -10V supply is obtained from the junction of CR19 and CR20.

5-28 LED DISPLAY

5-28 Figure 5-2 lists the connections to the individual LED seven segment display units.

LED PIN NUMBER TABLE



SEGMENT	PIN
A	1
B	13
C	10
D	8
E	7
F	2
G	11
D.P.	6

Figure 5-2

5-29 Figure 5-3 shows the alpha characters that indicate a malfunction in the unit.

ALPHA CHARACTER TABLE

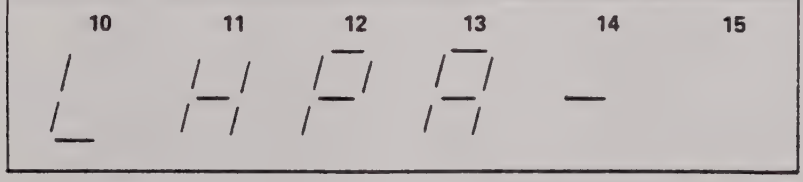


Figure 5-3

5-30 CURRENT SHUNTS

5-31 In the event of a malfunction in the DC current function, the probable failure

is the input protection fuse or the internal current shunt resistors. A simple continuity check will verify the integrity of the input fuse. The Valhalla Model 4440 may be used to trouble shoot its own current shunts. To check the current shunts, select the 2000 range and the KΩ function. Connect the V-Ω-F front panel terminal to the left side of R85 through R89 for signs of heat damage. Replace the defective resistor with a precision wire wound resistor of the same type and tolerance.

5-32 For troubleshooting the more complex feedback systems of the integrator, ohms converter and AC converter, refer to the theory of operation, SectionIV.

Valhalla Scientific Inc

PARTS LIST

REF. DES.	V.S. P/N	DESCRIPTION	MFG.	MFG. P/N
B 1-4	5-10029	Battery, Alkaline "D"		E95
C 3	2-10000	Cap.Cerm .005μf	56287	5GAD50
C 1-2 ,8,34	2-10009	Cap. Cerm. .001UF	56289	5GAD10
C 4	2-10002	Cap. Cerm. 500pf	56289	5GAT50
C 5, 6	2-10010	Cap. Cerm 39pf	56289	5GAQ39
C 7,16-18,20,25,33, 35,41	2-30001	Cap. Tan 10uf 10V	05397	T360B106M010AS
C 9-13,28,30,36	2-10000	Cap. Cerm. .005uf	56289	5GAD50
C 14	2-70002	Cap. Var. 1-3pf	Johnson	278-0103-005
C 15	2-30006	Cap. Tan .47uf 10V	05397	T360B474M010AS
C 19	2-30002	Cap. Tan 33uf 10V	05397	T360B336M010AS
C 21	2-50000	Cap. Poly .22uf	27556	PA2A224
C 22, 29	2-10005	Cap. Cerm. 50pf	56289	5GAQ50
C 23, 42	2-10004	Cap. Cerm. .02uf	56289	5GAS20
C 24,26,27	2-10007	Cap. Cerm. 330pf	56289	5GAT33
C 31	2-30000	Cap. Tan 4.7uf 10V	05397	T360B475M010AS
C 32	2-30003	Cap. Tan 47uf 10V	05397	T360B476M010AS
C 37	2-70000	Cap. Var 1-12pf	73899	VC58G
C 38	2-20011	Cap. Mica 1000pf	81349	CM06D102J03
C 39	2-60002	Cap. Paper .1uf	56289	225P10491
C 40	2-10003	Cap. Cerm. 20pf	56289	5GAQ20
C 43	2-70001	Cap. Var. 2-12pf		21FG010
C 44	2-40004	Cap. Elec. 2200uf		16T2200
CR 1,2,7-9,12-16, 19-24	3-20000	Diode	07263	IN4148
CR 3-6, 18	3-20002	Diode Rect.	07263	IN4001
CR 17	3-20001	Diode Zener	07263	IN821
DS 1	5-10120	LED 1 Display	28480	5082-7656C
DS 2-5	5-01010	LED 0-9 Display	28480	5082-7650C
F 1,2	5-04001	Fuse, 2A	75915	3GA2A
IC 1	3-30022	IC Level Shifter	86684	CD4054AE
IC 2, 3	3-30023	IC Quad Switch	86684	CD4066BF
IC 4	3-30024	IC Quad NOR	86684	CD4001AE
IC 5	3-30025	IC Quad Ex. OR	86684	CD4030AE
IC 6, 8	3-30026	IC Dual D Flip Flop	86684	CD4013AE
IC 7	3-30029	IC LSI	Hughes	HCTR4010
IC 9	3-30027	IC Quad NAND	86684	CD4011AE
IC 10	3-30106	IC Decoder Driver	01295	74LS47
IC 11	3-30012	IC LSI Timer	Mostek	Mk5009P
IC 12 ,21	3-30074	IC Op Amp	27014	LF356H
IC 17	3-30107	IC FET Op-Amp	27014	LF351H
IC 13	3-30017	IC Op-Amp	27014	LM308N

REF. DES.	V.S. P/N	DESCRIPTION	MFG.	MFG. P/N
1C14,16	3-30013	1C Op-Amp	27014	LM301H
1C15	3-30031	1C Quad Op-Amp	27014	LM324N
1C18	3-30002	1C Quad NAND	27014	SN7400N
1C19	3-30032	1C Decade Counter	01295	SN74LS196
1C20	3-30033	1C Decade Counter	86684	CD4017AE
1C22	3-30035	1C Voltage Reg.	27014	LM320-5.0T
J1	5-10030	Banana Jack Red	05276	1581-Red
J2	5-10032	Banana Jack Blk	05276	1581-Blk
J3	5-10031	Banana Jack Wht	05276	1581-Wht
J4	5-10033	Connector Pwr		16PJ121
Q1-6,11,12	3-10003	Transitor NPN	04713	2N5172
Q8	3-10015	Transistor NPN	04713	MJE3439
Q9,13	3-10000	Transistor FET	15818	U1899E
Q14,15	3-10004	Transistor FET	15818	P1087E
R1,2,4,6,7,48	1-01073	Res Fxd 47K 1/4W 5%	81349	RC07GF473J
R3,60,61,102,108	1-50005	Res Var 50K 20%	71450	X201R503
R5,25-27,38,75,106	1-01081	Res Fxd 100K 1/4W 5%	81349	RC07GF104J
R8	1-01120	Res Fxd 12M 1/4W 5%	81349	RC07GF126J
R9	1-01120	Res Fxd 12M 1/4W 5%	81349	RC07GF126J
R10, 101	1-01043	Res Fxd 1.5K 1/4W 5%	81349	RC07GF152J
R18	1-01067	Res Fxd 24K 1/4W 5%	81349	RC07GF243J
R19,49	1-01021	Res Fxd 100 1/4W 5%	81349	RC07GF101J
R20, 58		Factory Select		
R21	1-50002	Res Var 1K 20%	71450	X201R102
R22	1-10038	Res Fxd 90.9K .1%	81349	RN60C9092B
R23,36,69	1-50000	Res Var 100 20%	71450	X201R101
R24,44,45,59,62,66 68,70,71	1-10037	Res Fxd 10K .1%	81349	RN60C1002B
R28,31,105,110	1-01061	Res Fxd 10K 1/4W 5%	81349	RC07GF103J
R29	1-10039	Res Fxd 274K 1%	81349	RN50C2743F
R30	1-01080	Res Fxd 91K 1/4W 5%	81349	RC07GF913J
R33,34,46,73,74, 76,77	1-10049	Res Fxd 100K .1%	81349	RN60C1003B
R37	1-10041	Res Fxd 432	81349	RN60C4320F
R39,109,54	1-01128	Res Fxd 1000M	81349	RC07GF108J
R40	1-01109	Res Fxd 3.3M 1/4W 5%	81349	RC07GF335J
R41	1-10040	Res Fxd 4.42K	81349	RN60C4421F
R42	1-50007	Res Var 250 20%	71450	X201R251
R43,103	1-01082	Res Fxd 120K 1/4W 5%	81349	RC07GF124J
R47	1-10028	Res Fxd 24.9K 1%	81349	RN60C2492F
R50,55	1-01045	Res Fxd 2K 1/4W 5%	81349	RC07GF202J
R51	1-01041	Res Fxd 1K 1/4W 5%	81349	RC07GF103J
R52	1-01065	Res Fxd 20K 1/4W 5%	81349	RC07GF203J

Valhalla Scientific Inc

PARTS LIST

REF. DES.	V.S. P/N	DESCRIPTION	MFG.	MFG. P/N
R 53	1-01051	RES FXD 3.9K	81349	RC07GF392J
*	1-10090	Matched Atten. Set 9.9M, 1K, 99K		
R 56, 80, 114	1-01007	Res. Fxd. 10 1/4W 5%	81349	RC07GF100J
R 57	1-01097	Res. Fxd. 750K 1/4W 5%	81349	RC07GF754J
R 63	1-01102	Res. Fxd. 1.5M 1/4W 5%	81349	RC07GF155J
R 64, 72, 111	1-01053	Res. Fxd 4.7K 1/4W 5%	81349	RC07GF472J
R 65, 100	1-01028	Res. Fxd. 270 1/4W 5%	81349	RC07GF271J
R 67, 78	1-10036	Res. Fxd. 1.62K .1%	81349	RN60C1621B
R 81, 82	1-01048	Res. Fxd. 2.7K 1/4W 5%	81349	RC07GF272J
*R 83	1-10090	Res. Fxd. 9.9M	81349	
*R84	1-10090	Res. Fxd. 99K	00002	
R 85	1-20004	Res. Fxd. 900 .05%	00002	J110-900
R 86	1-20003	Res. Fxd. 90 .5%	00002	J110-90
R 87	1-20002	Res. Fxd. 9 .5%	00002	J110-9
R 88	1-20028	Res. Fxd. .9 .1%	00002	J110-.9
R 89	1-20027	Res. Fxd. .1 .1%	00002	J140-.1
*R 90	1-10090	Res. Fxd. 1K	00002	
R 91, 92	1-01093	Res. Fxd. 470K 1/4W 5%	81349	RC07GF474J
R 93-96, 11-17	1-01031	Res. Fxd. 390 1/4W 5%	81349	RC07GF391J
R 97	1-01100	Res. Fxd. 1M 1/4W 5%	81349	RC07GF105J
R 98	1-01119	Res. Fxd 10M 1/4W 5%	81349	RC07GF106J
R 99,	1-01036	Res. Fxd. 620 1/4W 5%	81349	RC07GF621J
R 104	1-01075	Res. Fxd. 56K 1/4W 5%	81349	RC07GF563J
R 107	1-01033	Res. Fxd. 470 1/4W 5%	81349	RC07GF471J
S 1, 2	5-03005	Push Button Switch 6X8	71590	5-03005
S 3	5-03015	Toggle Switch	C & K	1201
T 1	4-20006	Transformer		4440-010
Y 1	5-02000	1MHz Crystal	81349	HC6-1MHz
8 ea.	5-10199	Fibre Washer	Smith	2161
4 ea.		#4 Self Tapping Screw	1/2" lg.	
4 ea.		#4 . Washers, Split Lock		
4 ea.	5-10198	1/8" Spacer	Smith	8880
1 ea.	5-10094	Fuse Holder	75915	155120
1 ea.	4-30009	P.C. Board	53504	4440-700F
1 ea.	4-30010	P.C. Board	53504	4440-701F
1 ea.	5-10042	24 Pin IC Socket		
1 ea.	5-10008	16 Pin IC Socket		
2 ea.	5-10041	14 Pin IC Socket		
1 ea.	5-10049	Battery Box	Wakman	L103
1 ea.	4-10234	Front Panel	53504	4440-213
1 ea.	4-10130	Chassis	LaFrance	CH-250 Beige
1 ea.	4-10235	Rear Panel	53504	4440-214
1 ea.	5-10018	Fuse Holder		42004A
8 inches	5-10239	Velcro Hook	United Textile	VN06330Hk
8 inches	5-10240	Velcro Loop	United Textile	VN06660LP

Valhalla Scientific Inc

PARTS LIST

REF. DES.	V.S. P/N	DESCRIPTION	MFG.	MFG. P/N
1 ea.	4-10130	Chassis (includes)	La France	CH250 Beige
1 ea.		Handle (60128)		
2 ea.		Spring (60157)		
2 ea.		Button (60156)		
2 ea.		#4 Screw (60164)		
2 ea.		Cap (60170)		
4 ea.		Feet (60129)		
4 ea.		6-32x2½ Screw		
1 ea.		Top Cover (60119-1)		
8 ea.		Spacers (60130-2)		
1 ea.		Side Expanders (60120)		
1 ea.		Bottom Cover (60119-2)		

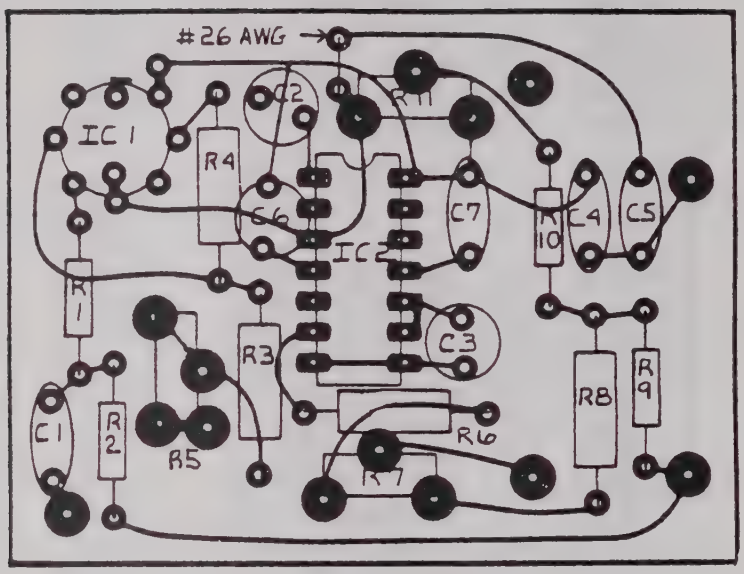
Valhalla Scientific Inc

PARTS LIST

REF. DES.	V.S. P/N	DESCRIPTION	MFG.	MFG. P/N
C 1	2-10000	CAP. CERM .005µf	56289	5GAD50
C 2,3	2-30007	CAP. TAN 2.2µf	05397	T390A225M01AS
C 4,5	2-60002	CAP. PAPER .1µf	56289	225P10491
C 6	2-30008	CAP. TAN 6.8µf	05397	T390B685M01AS
C 7	2-10002	CAP. CERM 500pf	56289	5GAT50
IC 1	3-30074	IC FET OP-AMP	27014	LF356H
IC 2	3-30045	IC RMS TO DC CONV.	ANALOG DEVICES	AD536JD
R 1	1-01081	RES FXD 100K 1/4W 5%	81349	RC07GF104J
R 2	1-01128	RES FXD 100m 1/4W 5%	82349	RC07GF108J
R 3	1-10053	RES FXD 2.43K 1.4W 1%	81349	RN60C2431F
R 4	1-10054	RES FXD 22.1K 1/4W 1%	81349	RN60C2212F
R 5	1-50000	RES VAR 100Ω 20%	71450	X201R101
R 6	1-10055	RES FXD 113K 1/4W 1%	81349	RN60C1133F
R 7	1-40004	RES VAR 500Ω 20%	71450	X201R501
R 8	1-10056	RES FEX 12.1K 1/4W 1%	81349	RN60C1212F
R 9	1-01020	RES FEX 100Ω 1/4W 5%	81349	RC07GF101F
R 10	1-01100	RES FEX 1M 1/4W 5%	81349	RC07GF105F
R 11	1-50005	RES VAR 50K 20%	71450	X201R503
	4-30021	P.C. BOARD	53504	4440-704
	5-10198	1/8 STANDOFF	83330	8880

MODEL: 4440

TITLE: RMS TO DC CONVERTER



TRMS AC CONVERTER

CALIBRATION PROCEDURE

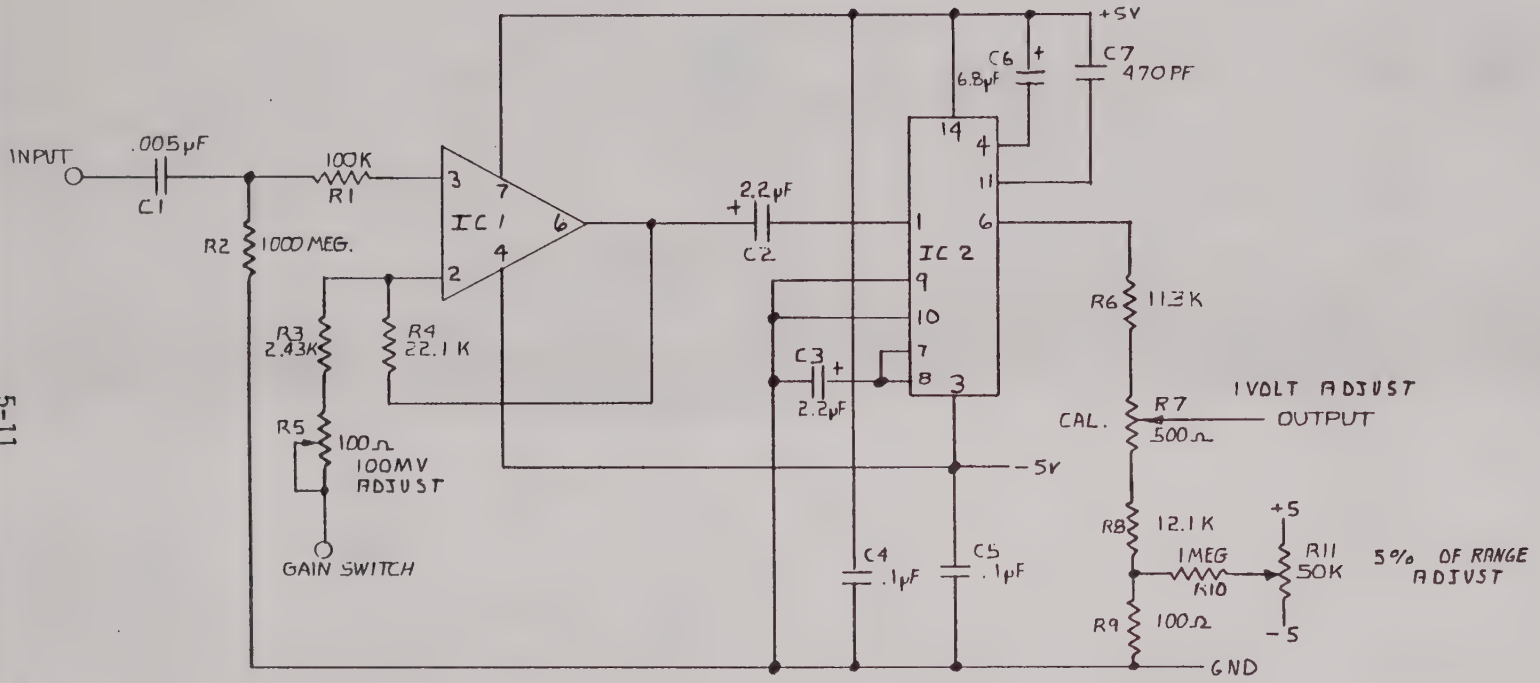
Select the ACV function and the 2 volt range. Apply 0.1000 VRMS at 1 KHz to the input terminals and adjust R11 for an indication of 0.1000 ±5 digits.

Apply 1.0000 VRMS at KHz to the input terminals and adjust R7 for an indication of 1.0000 ±5 digits.

Select the ACV function and the 200 MV range. Apply 100.00 MVRMS at 1 KHz to the input terminals and adjust R5 for an indication of 100.00 ±5 digits.

Select the ACV function and the 20 volt range. Apply 10.000 VRMS at 10 KHz to the input terminals and adjust C37 for an indication of 10.000 ±5 digits. (C37 is located behind the front panel input terminals).

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
	A	ADDED MODIFICATION NOTE C.R.E.	1-27-82	

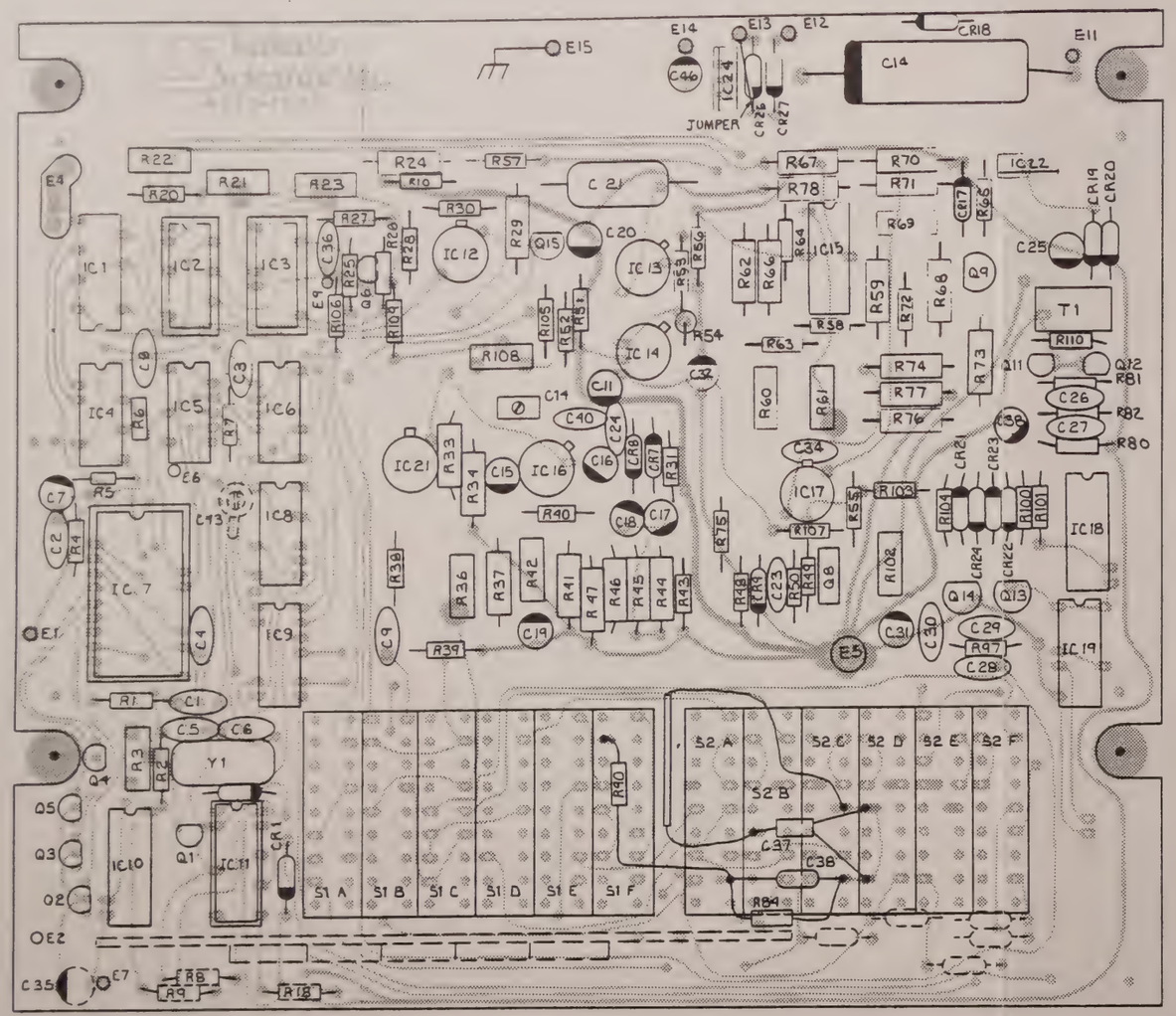


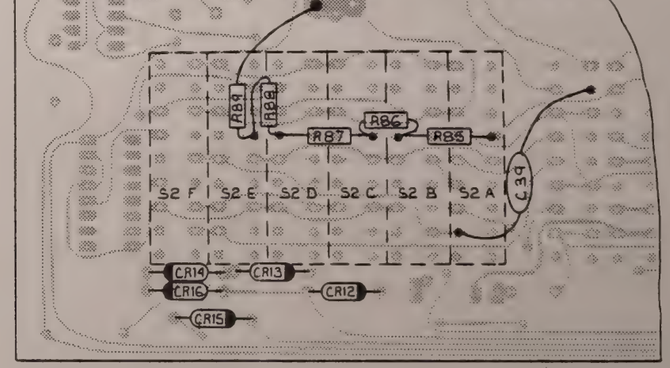
MODIFICATION FROM 4440 TO 4440 AF (3Hz)

CHANGE	FROM	TO
C2	2.2μ	47μ (2-30003)
C3	2.2μ	47μ (2-30003)
C6	6.8μ	33μ (2-30002)

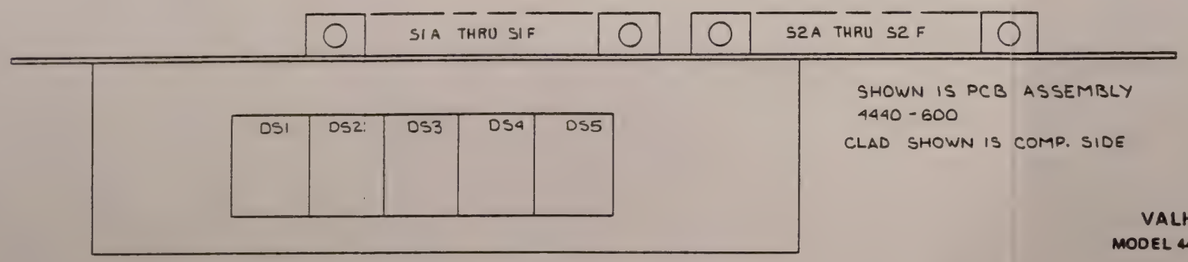
NEXT ASSY	USED ON	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: FRACTIONS DECIMALS ANGLES ± .XX ± ± .XXX ±	CONTRACT NO.	VALHALLA SCIENTIFIC
APPLICATION		MATERIAL	APPROVALS / DRAWN / CHECKED	4440 TRMS AC CONV.
		FINISH	DATE	SIZE B · CODE IDENT NO. 53504 · DRAWING NO. 4440-071 · REV. A
		DO NOT SCALE DRAWING	P.C 4440-704	SCALE · SHEET 1 OF 1

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED





SHOWN IS BOTTOM VIEW
OF 4440-600.
CLAD SHOWN IS CIRT. SIDE



SHOWN IS PCB ASSEMBLY
4440-600
CLAD SHOWN IS COMP. SIDE

NOTES:

1. FOR SCHEMATIC SEE DWG. NO. 4440-070.
2. FOR UNIT ASSY. SEE DWG. NO. 4440-400.
3. FOR WIRE TAB SEE DWG. NO. 4440-050.

VALHALLA SCIENTIFIC
MODEL 4440 ASSEMBLY DIAGRAM

MATERIAL	DRAWN C.R.E.		Valhalla Scientific Inc.		
	CHECKED		SAN DIEGO, CALIFORNIA		
	APPR				
FINISH			P.C.B ASSY. 4440-600		
	SCALE 2:1	SHEET 1 OF 1	CODE IDENT NO 53504	SIZE D	DRAWING NO 4440-600 REV G

REVISIONS			
ZONE	LTR	DESCRIPTION	DATE	APPROVED
	F	ECO 02. Rm 10/81		

TO EXTERNAL BATTERY CHARGER

INTERNAL BATTERY PACK

POWER ON

QTY REQD	CODE IDENT	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION

PARTS LIST

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ARE:
FRACTIONS ± DECIMALS .XX ± .XXX ± ANGLES ±

MATERIAL

FINISH

NEXT ASSY | USED ON

APPLICATION

DO NOT SCALE DRAWING

Valhalla Scientific Inc.

SIZE	CODE IDENT NO.	DRAWING NO.
D		4440-070F

SCALE | SHEET OF

FEDERAL SUPPLY CODE
for
MANUFACTURERS CATALOGING HANDBOOK H4-1

00001	Monsanto, Electronic Special Products, Cupertino, Calif.
00656	Aerovox Corporation, New Bedford, Mass
00853	Sangamo Electric Company, Pickens, S.C.
01121	Allen-Bradley Company, Milwaukee, Wisc.
01255	Litton Industries, Inc., Beverly Hills, Calif.
01281	T R W Semiconductors, Inc., Lawndale, Calif.
01295	Texas Instruments, Inc., Dallas, Texas
02335	Fairchild Controls Corp., Hicksville, LI, N.Y.
02660	Amphenol Corporation, Broadview, N.Y.
03507	General Electric Company, Syracuse, N.Y.
04713	Motorola Semiconductor Prod., Inc., Phoenix, Ariz.
04963	3-M, St. Paul, Minn.
05276	Pomona Electronics Co., Inc., Pomona, Calif.
05397	Kemet, Union Carbide Corp., Cleveland, Ohio
05820	Wakefield Engineering, Inc., Wakefield, Mass.
07088	Kelvin Electric Company, Van Nuys, Calif.
07256	Silicon Transistor Corp., Garden City, N.Y.
07263	Fairchild Camera and Instr. Corp., Mt. View, Calif.
07716	I R C, Incorporated, Burlington, Iowa
07910	Continental Devices, Hawthorne, Calif.
08065	Accurate Rubber and Plastics Co., San Diego, Calif.
09026	Babcock Electronics Corp., Costa Mesa, Calif.
12405	Hysol Corporation, El Monte, Calif.
12406	Elpac, Incorporated, Fullerton, Calif.
12697	Clarostat Mfg. Co., Incorporated, Dover, N.H.
13454	Texas Crystals, River Grove, Ill.
14655	Cornell-Dubilier Elect. Corp., Newark, N.J.
14752	Electro Cube, Incorporated, San Gabriel, Calif.
16758	Delco Radio Div., General Motors, Kokomo, Ind.
17838	Mektron, California General, Inc., Chula Vista, Calif.
18324	Signetics, Sunnyvale, Calif.
18722	R C A, Mountaintop, Pa.
21604	Buckeye Stamping Company, Columbus, Ohio
25684	Victoreen Instrument Co., Inc., Oak Lawn, Ill.
27014	National Semi-Conductor Corp., Santa Clara, Calif.
27556	IMB Electronic Products, Santa Fe Springs, Calif.
28480	Hewlett-Packard Co., Palo Alto, Calif.
30983	Electra/Midland, San Diego, Calif.
44655	Ohmite Manufacturing Company, Skokie, Ill.
71279	Cambridge Thermionic Corp., Cambridge, Mass.
71400	Bussmann Mfg. Div., McGraw-Edison Co., St. Louis, Mo.
71450	CTS Corporation, Elkhart, Ind.
71468	ITT Cannon Electric, Inc., Los Angeles, Calif.
71590	Centralab Div., Globe-Union, Inc., Milwaukee, Wisc.
71785	Cinch Manufacturing Company, Chicago, Ill.
73899	J F D Electronics Company, Brooklyn, N.Y.
75915	Littlefuse, Incorporated, Des Plaines, Ill.
76055	Mallory Controls, Frankfort, Ind.
76493	J. W. Miller Company, Los Angeles, Calif.
78488	Stackpole Carbon Company, St. Marys, Pa.
80294	Bourns, Incorporated, Riverside, Calif.
81095	Triad Transformer Corp., Venice, Calif.
81312	Winchester Electronics, Oakville, Ct.
81349	Military Spec., Standardization Division, Chicago, Ill.
82389	Switchcraft, Incorporated, Chicago, Ill.
83330	Herman H. Smith, Inc., Brooklyn, N.Y.
84171	Arco Electronics, Inc., Great Neck, N.Y.
86684	R C A, Harrison, N.J.
88245	Useco Div., Litton Industries, Van Nuys, Calif.
90201	Mallory Capacitor Company, Indianapolis, Ind.
91637	Dale Electronics, Inc., Columbus, Neb.
91929	Micro Switch Div., Honeywell, Inc., Freeport, Ill.
92194	Alpha Wire Corporation, Elizabeth, N.J.
93332	Sylvania Electric Products, Inc., Woburn, Mass
98978	IERC, Burbank, Calif.
00002	Jordan Electronics, Van Nuys, Calif.
53504	Valhalla Scientific, Inc., San Diego, Calif.

DIGITAL MULTIMETER-COUNTER
MODEL 4440

ORDERING INFORMATION

MODEL 4440 DIGITAL MULTIMETER

Option "HV-2" 2% 36 KV Probe .....
Option "CC" Meter and Accessory Carrying Case .....
Option "A" Battery Charger/Eliminator .....
Option "I" 20 AMP Current Shunt .....
Option "F" 20 MHz Frequency Counter .....
Option "B" Rechargeable Batteries (8 hours) .....
Option "HDB" Rechargeable Batteries (40 hours) .....
Option "AB" Alkaline Batteries (Spares) .....
Option "AC" Internal 115 VAC Power Supply .....
Option "TEMP" Temperature Probe (1 mv/°C) .....
Option "C" Shielded Input Cable Set .....
Option "R" 19" Single Unit 3 1/2" Rack Mount .....
Option "RR" 19" Dual Unit 3 1/2" Rack Mount .....
Option "RMS" Measures True rms AC Voltage and Current .....

Valhalla Scientific Inc.
7576 Trade St., San Diego, CA 92121 (714) 578-8280

50389